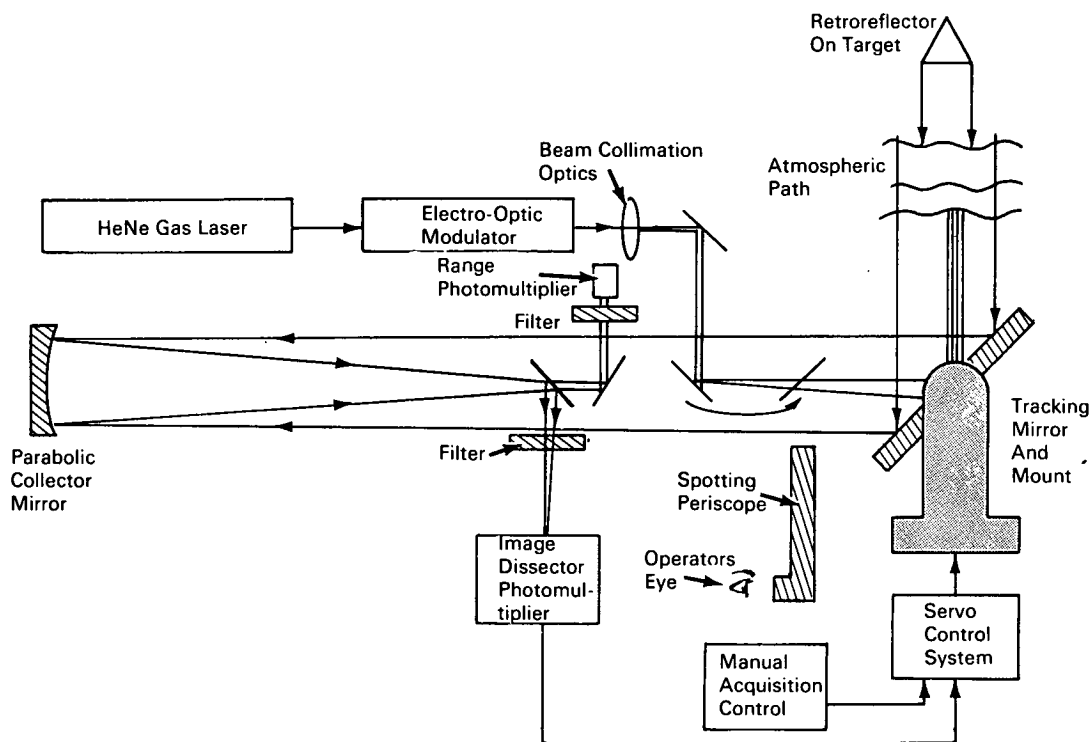


# NASA TECH BRIEF



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## Precision CW Laser Automatic Tracking System Investigated



A precision laser tracker has been constructed and tested which is capable of tracking a low acceleration target to an accuracy of about 20 microradians rms. In tracking high acceleration targets the error is directly proportional to the angular acceleration. For an angular acceleration of  $0.6 \text{ radian/second}^2$  the measured tracking error was about 0.1 milliradian.

The basic components in this tracker, similar in configuration to a heliostat, are a laser and an image dissector, mounted on a stationary frame, and a servo controlled tracking mirror. The daytime sensitivity

of this system is approximately  $3 \times 10^{-10} \text{ watts/meter}^2$ ; the ultimate nighttime sensitivity is approximately  $3 \times 10^{-14} \text{ watts/meter}^2$ .

Experimental tests were performed to evaluate both dynamic characteristics of this system and the system sensitivity. Dynamic performance of the system was obtained using a small rocket covered with retroreflective material launched at an acceleration of about 13 g at a point 670 feet from the tracker. The daytime sensitivity of the system was checked using an efficient retroreflector mounted on a light aircraft.

(continued overleaf)

This aircraft was tracked out to a maximum range of 15 km which checked the daytime sensitivity of the system measured by other means. The system has also been used to passively track stars and the Echo I satellite. The system also passively tracked a +7.5 magnitude star, and the signal-to-noise ratio in this experiment indicates that it should be possible to track a +12.5 magnitude star.

The tracking accuracy against low acceleration targets is comparable to the accuracy of a star tracker. However, the laser tracker has the added capability of measuring range to the target. The accuracy exceeds that which can be provided by a high performance radar.

Interest in high precision tracking results from the instrumentation tracking requirements that arise at the missile ranges and other test stations. The advantage of optical tracking over radar tracking is that it is not affected by undesired reflections from surrounding objects, and the accuracy is somewhat less affected by variations in the index of refraction of the atmosphere. Laser tracking, as contrasted to passive optical tracking, has the advantage of discriminating against

other optical sources and also has the capability of simultaneously measuring range. High precision tracking is also a necessary part of long-range optical communications which can be efficiently accomplished only by using very narrow beams.

**Note:**

Additional details are contained in the report: "Precision CW Laser Automatic Tracking System," by R. F. Lucy et al, Sylvania Electronic Systems, 18 November 1965, which is available from:

Technology Utilization Officer  
Marshall Space Flight Center  
Huntsville, Alabama 35812  
Reference: B66-10629

**Patent status:**

No patent action is contemplated by NASA.

Source: R. F. Lucy, C. J. Peters,  
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of Sylvania Electronic Systems  
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